Effect of Aerobic and Pilates Exercises on Physical Performance, Sleep Quality, Psychological Well-being and Menopausal Symptoms in Perimenopausal Women

SHORT SYNOPSIS

Submitted in partial fulfilment of the requirement of the degree of

DOCTOR OF PHILOSOPHY

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(Deemed to be University)

by

Scholar Name – Avi Choudhary
Registration number: **23-24/Ph.D/S/001**

Under the supervision of

Dr. Kshitija Bansal
Professor
School of Allied Health Sciences

Department of Physiotherapy
School of Allied Health Sciences

Manav Rachna International Institute of Research & Studies,

Sector-43, Surajkund –Delhi Road, Faridabad – 121004

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SCHOOL OF ALLIED HEALTH SCIENCES

Certificate

I hereby declare that short synopsis Title "Effect of Aerobic and Pilates Exercises on Physical Performance, Sleep Quality, Psychological Well-being and Menopausal Symptoms in Perimenopausal Women" being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in the Department of Physiotherapy under School of Allied Health Sciences of Manav Rachna International Institute of Research & Studies, Faridabad during the academic year 2024-2025. It is a bona fide record of original work carried out under the supervision of Dr. Kshitija Bansal and has not been submitted in full or part to any other university or institute for degree or diploma. Further, it is certified that short synopsis is plagiarism free and proof has been submitted.

Avi Choudhary
12303MRIIRSPHD2N00

Signature of the Supervisor
Dr. Kshitija Bansal
Professor, Department of Physiotherapy,
School of Allied Health Sciences

13.06.2025
(Chairperson, DRC)

16/6/25
(Dean, School of Allied Health Sciences)

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ABSTRACT

Menopause is defined as the permanent cessation of menstruation which occurs as a result of loss of ovarian follicles and is confirmed after 12 consecutive months of amenorrhoea i.e., complete absence of menstruation. Peri-Menopause, transition to menopause is usually lasts about 7 years but can extends up to a period of 14 years. During this phase, significant hormonal fluctuations occur which leads to various symptoms such as vasomotor disturbances, genitourinary discomfort, psychological symptoms, physical discomfort, sleep issues, cognitive decline, impaired sexual function, reduced bone density, and decreased physical performance. In India, a lot of variation has been found in the prevalence of menopausal symptoms across various zones. These symptoms can be managed with hormone replacement therapy but this therapy causes a lot of side effects and contraindications which restrict its use in many menopausal women. To deal with this, physical exercises can be used as an alternative to hormone therapy by improving the bodily functions and minimizing the menopausal symptoms. Both aerobic exercise and Pilates exercise are found to relieve a variety of these symptoms, although Pilates is not explored much and also there is a lack of one effective intervention. Additionally. there is lack of studies based on biopsychosocial model, which focuses on holistic development by addressing the biological, psychological, and social factors that influence health and illness. Therefore, we are conducting this study in two phases to determine the level of physical performance and menopausal symptoms in perimenopausal women in the first phase and to compare the effect of the two different form of exercise programs, namely aerobic exercise and Pilates exercise in control or reducing these symptoms in the second phase.

Keywords: *Aerobic exercise, Menopausal Symptoms, Perimenopause, Physical Performance, Pilates Exercise.*

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INTRODUCTION

Permanent cessation of the menstruation is known as menopause and it primarily occurs due to the loss of ovarian follicles and is confirmed after one year i.e., 12 months of amenorrhoea which is defined as the complete absence of menstruation (Pallikadavath, S., et al., 2016). Age of natural menopause in Indian women shown a great variation across the different regions. In East region of India, it is found to be 47.3 years while in western India, it is 46.2 years, 45.5 years and 46.1 year in North and South India respectively. Further, notable differences in the average age at natural menopause were observed between North and East, North and Central regions, West and Central region and between South and Central India (Ahuja, M., et al., 2016).

Discussing the etiology of menopause, as women age, the number of ovarian follicles decreases due to the natural processes of atresia and ovulation. This reduction in number of ovarian follicles leads to a reduction in granulosa cells, which are primarily responsible for the production of estradiol and inhibin B. As the level of estrogen and inhibin declines, their regulatory inhibition of gonadotropins is lost which results in an increase in the secretion of sex hormones such as FSH (Follicle-stimulating hormone) and LH (Luteinizing hormone) (Peacock et al., 2024). This hormonal imbalance further disrupts the hypothalamic-pituitary-ovarian axis, causing endometrial development to fail. Consequently, menstrual cycles become irregular, eventually ceasing altogether (Peakock, K., et al., 2024).

Peri-Menopause, transition to menopause is usually lasts about 7 years but can extends up to a period of 14 years (Prashad, J.B., et al., 2021). Beginning of perimenopausal timeframe is marked by the shortening of the follicular phase which in turn causes more frequent menses. Secondarily, the menstrual cycle shows an increase in its length. After that, Cycles finally becomes anovulatory. As a result of this, Menstruation pauses (Peacock, K., et al., 2024). Stages of Reproductive Aging Workshop (STRAW) is a staging system which defines perimenopause as including three stages - early menopausal transition, late menopausal transition and early post-menopause. These stages are characterized by more than 60 days of amenorrhea (early transition to menopause), and concluding after 12 months of amenorrhea (Post Menopause Stage) (Harlow, S.D., et al., 2012).

At present, median age in India is 28.2 years which means that there are a majority of women will be reaching their menopause in near future as majority of women in India reaches the menopause between the age of 40-49 years. Most prominent physiological changes during this phase is the fluctuations in the oestrogen levels which typically lasts around four years

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(McKinlay, S. M., et al., 1996). This fluctuation in the level of hormone leads to various symptoms such as vasomotor symptoms (75-80%), genitourinary discomforts (50-70%), psychogenic symptoms (70%), Physical discomfort, Sleep related difficulties, Cognitive decline, impaired sexual functions and bone growth (Peakock, K., et al., 2024). Few studies are showing that as women approaches the age of menopausal transition, there is a risk of increased anxiety and depression which in turn affects their physical health and quality of life adversely (Gibson, C. J., et al., 2017 & Li. Y., et al, 2014). Also sleep related discomforts are also very common in menopausal women due to various biosocial, psychological, genetic, and also behavioural risk factors (Massoud, E.F., et., 2023).

When it comes to the management of menopausal symptoms, hormone replacement therapy but this therapy causes a lot of adverse effects and contraindications which restrict its use in many menopausal women (Patel, B., et al., 2022). There are a variety of non-hormonal options which are available for controlling these symptoms as aerobic exercises, resistance exercises, cognitive behavioural therapies, weight loss programs, yoga and acupuncture, but these forms of treatment are not very well supported in the literature (Madsen, T. E., et al., 2023 & Zou, L., et al., 2017). Although there are few studies available showing that regular physical activity might leads to notable reduction in the occurrence of menopausal symptoms and improves general health status, studies have shown the association of moderate physical activity level with less severe menopausal symptoms (Dąbrowska-Galas, M., et al., 2019). Therefore, we are conducting this study in two phases to determine the level of physical performance and Menopausal Symptoms in perimenopausal women in the first phase and to compare the effect of the two different form of exercise programs, namely aerobic exercise and pilates exercise in controlling or reducing these symptoms in the second phase.

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Review of literature

Effect of Exercises on Sleep Quality

There was a review conducted to explore the effect of various Exercise interventions such as aerobic, Yoga, Qi Gong and walking and the findings of that review suggested that exercises can lead to improved sleep quality and effective reduction in the symptoms of insomnia among women undergoing perimenopause, Qigong being the most effective intervention (Mengnan, Z., et al, 2023). Other forms of exercises are also found to be successful in increasing the quality of Sleep (Zhao, T., et al, 2022).

Effect of Exercises on Psychological Well-being

A study conducted to evaluate the effect of aerobic training concluded that the exercises can lead to better sleep quality and significant improvement in the anxiety and depression among the perimenopausal women (Zhao, Y., et al., 2022).

Effect of Physical activity and Exercise Interventions on Menopausal symptoms

A comprehensive review of systematic reviews which is inclusive of 80 relevant studies with 8983 subjects were conducted to identify the effectiveness of various forms of physical activity on a variety of the menopausal symptoms (Money, A., et al., 2024). This review suggested that yoga was the most effective intervention with rich evidence in terms of the number of studies conducted which showed the improvement in physical, urogenital, vasomotor and psychological symptoms. Findings for the effectiveness of aerobic exercise were inconclusive, but there were some studies showed the beneficial effects on the symptoms of menopause. Further analysis aimed at comparing the yoga with aerobic exercises were unable to bring the clarity on the points of difference in effectiveness of the both (Money, A., et al., 2024). As per this review, resistance exercises have very limited evidence. After reviewing the findings, we can say that there is lack of good-quality evidence to establish the superiority of any one form of exercise over the other which suggests that there is an urgent need for high-quality RCTs in this area to identify the efficacy of the exercise interventions (Money, A., et al., 2024).

Taking about the effectiveness of pilates training in menopausal women demonstrated that these exercise programs are effective in decreasing these symptoms and leads to increase in strength and flexibility of lumbar area (Lee, H., et al., 2016) and also results in reduction of Fatigue (Mohamed, D. M. A., et al, 2023).

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Exercises and Physical Performance in Menopausal Women

Ageing leads to the decrease in physical performance which results in reduced muscle strength, inefficiency to produce quick forces and decreased mobility and walking speed which will further leads to the loss of balance, and disabilities among elderly population. Literature also suggested that decline in physical performance is faster in the women than the men specifically in middle age group. These disparities in different gender are occur due to the hormonal fluctuations which occurs during different menopausal stages (Bondarev, D., et al., 2018).

Evidences shown that postmenopausal women have the decreased muscle strength and power than the premenopausal women. A study conducted by Sowers et al. concludes that muscle strength reduces faster in middle-aged women in their postmenopausal stage in comparison to premenopausal and perimenopausal stages (Sowers, M., et al., 2007). But there are also few cross-sectional studies which contraindicates the findings of the previous study one of which conducted on 389 individuals of 40-65 years and concluded that there were no significant differences were observed in premenopausal, perimenopausal and postmenopausal phases in their habitual walking speed (Câmara, S., et al., 2015). Another follow-up study by Sowers et al demonstrated significantly higher reduction in the walking speed of middle-aged postmenopausal women (Sowers, M., et al., 2007).

Physical activity is a crucial determinant of the physical performance, greater muscle strength is related to physical activity in the postmenopausal women (Karine, D., et al., 2013). Deficiency of sex hormones during thus phase might have an effect on the skeletal muscle through reduction in physical activity. Previous Studies have shown a decrease in the energy expenditure and shift towards sedentary lifestyle during the phase of menopause. So, we can say that this decline in the physical performance during the phase of menopause may be an outcome of deficiency of estrogen as well as reduction of physical activity.

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Research Gaps and Problem Statement

Phase I

Although studies have investigated the prevalence of the symptoms of menopause among Indian women, but they primarily focused on post-menopausal women (Ahlawat, P., et al., 2019; Roy, B., et al., 2021) and rural populations (Singh, A., et al., 2014). Moreover, in majority of the studies, reproductive stage or age is not defined clearly. There is a need for research specifically targeting peri-menopausal women to assess the prevalence of sleep disturbances, psychological issues, and menopausal symptoms. This will help in understanding the disease burden, developing more effective interventions, and identifying risk and protective factors. Additionally, our study utilizes the biopsychosocial model to assess physical performance, sleep quality, and psychological well-being, recognizing that these factors are interrelated and can impact each other.

Phase II

Numerous studies have consistently demonstrated that regular aerobic exercise can significantly enhance sleep quality and psychological well-being (Sharma, S., et al., 2024; Zhao, Y., et al., 2022; Buchanan, D. T., et al., 2017). However, only a few numbers of studies have examined the outcome of Pilates exercise program on the quality of sleep, Psychological state, and fatigue reporting significant benefits (Almazán, A., et al.). While both types of exercise have shown positive outcomes, direct comparisons of their effectiveness in addressing the symptoms experienced by menopausal women as hot flushes, mood fluctuations are very scarce. Additionally, there is limited data on the optimal intensity and frequency of aerobics and Pilates for managing menopausal symptoms. As part of our study, which is based on the biopsychosocial model, we aim to evaluate the impact of one well-established form of exercise and another that is less explored but effective on physical performance, sleep quality, psychological well-being, and menopausal symptoms.

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Description of broad area-

In this study, we are going to evaluate the level of physical performance and the presence of menopausal symptoms among women experiencing perimenopause. In this study, we will also explore the potential benefits of aerobic and Pilates exercises in mitigating menopausal symptoms with special emphasis on sleep, psychological well-being and physical performance. It will delve into the physiological and psychological effects of these exercises on perimenopausal women, focusing on their impact on:

- Physical Performance
- Sleep Quality
- Psychological symptoms: Stress, Anxiety, and Depression
- Menopausal Symptoms

Through this study, we will be able to determine which form of exercise is more effective in addressing menopausal symptoms or is any specific exercise is effective for one type of symptoms and vice versa. We will also be discussing the potential mechanisms through which these exercises may alleviate symptoms, such as hormonal regulation, stress reduction, and improved physical fitness

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Aims and Objectives

Phase I

Aim:

To determine the level of physical performance, sleep quality, psychological well-being and menopausal symptoms among Perimenopausal women.

Objective:

- To determine the physical performance of perimenopausal women.
- To determine the sleep quality of perimenopausal women.
- To determine the psychological conditioning of perimenopausal women.
- To identify the menopausal symptoms, present in the perimenopausal women.

Phase II

Aim:

To study and compare the effectiveness of aerobic exercise and Pilates exercises on the physical performance, sleep quality, psychological well-being and menopausal symptoms among perimenopausal women.

Objective:

- To evaluate the effectiveness of aerobic exercise program on the physical performance, sleep quality, psychological well-being and the other symptoms of menopause among perimenopausal women.
- To evaluate the effectiveness of Pilates exercise program on the physical performance, sleep quality, psychological well-being and the other symptoms of menopause among perimenopausal women.
- To compare the effectiveness of aerobic exercises and Pilates exercises in improving physical performance, sleep quality, psychological well-being and menopausal symptoms among perimenopausal women.

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Research Questions / Hypothesis

Phase I –

1. What is the level of physical performance in perimenopausal women?
2. What is the level of sleep quality, psychological well-being and menopausal symptoms in peri-menopausal women?

Phase II –

Null Hypothesis:

- There will be no significant effect of aerobic exercise in improving the physical performance, sleep quality, psychological well-being and menopausal symptoms among perimenopausal women.
- There will be no significant effect of Pilates Exercises in improving the physical performance, sleep quality, psychological well-being and menopausal symptoms among perimenopausal women.
- There will be no significant difference in the effectiveness of aerobic Exercise and Pilates exercise in improving the physical performance, sleep quality, psychological well-being and menopausal symptoms among perimenopausal women.

Experimental Hypothesis:

- There will be significant effect of aerobic exercise in improving the physical performance, sleep quality, psychological well-being and menopausal symptoms among perimenopausal women.
- There will be significant effect of Pilates exercises in improving the physical performance, sleep quality, psychological ell-being and menopausal symptoms among perimenopausal women.
- There will be significant difference in the effectiveness of aerobic exercise and Pilates exercise in improving the physical performance, sleep quality, psychological well-being and menopausal symptoms among perimenopausal women.

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Research Methodology

Study Type:

Phase I – Cross Sectional Study.

Phase II – Experimental Study with 3 parallel groups.

Sample Size:

Phase I – 385 (US Slovin Formula)

Phase II – 81 (27 in each group). (Calculated by G Power, Effect size – 0.2, error prob ($\propto$)– 0.05, Power$(1-\beta)$ – 0.85)

Sampling Technique:

Purposive Sampling

Inclusion Criteria-

Phase I & Phase II

- Women with the age of 40-55 Years who are in peri-menopause (Stages of Reproductive Aging Workshop criteria - 2001),
- Able to read and write Hindi language,
- Women who are ready for performing Exercises (PARQ), and
- BMI – 18.5-29.9.

Phase II

- Women who are ready for performing exercises (PARQ), and
- Any 4 out of 7 physical performance tests affected.

Exclusion Criteria-

- Receiving Current therapies such as Hormone Therapy, psychotropic medications, or sleeping pills,
- Presence of any systematic Illness,
- Any Diagnosed case of Musculoskeletal, Neurological, Cardio-respiratory and Psychiatric Illness in past six months,
- Any diagnosed case of Osteoporosis, and
- Recent Surgery.

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Outcome Measures:

I. **Physical Fitness Battery –**

i. Hand Grip Strength

ii. Wall Squat Test – For Strength and Endurance

iii. Abdominal Plank Test – For Abdominal Strength and Endurance

iv. Sit and Reach Flexibility – For Flexibility

v. Berg Balance Scale – For Balance

vi. 10 X 4 Shuttle Run Test – For Agility

vii. **6-minute walk test** – 6-minute walk test is used to assess the aerobic capacity and endurance. This test provides the valuable information regarding Pulmonary and Cardiovascular systems during the physical activity. (Koley, A., et al., 2024)

viii. BMI – BMI will be assessed to estimate relative body fat with a tape measure and weight scale after measuring the height and weight of the person and then height and weight scores are to converted to round figure by adding the 0.5.

II. **Pittsburg Sleep Quality Index-Hindi** – PSQI is a self-administered questionnaire of 19 items which is designed to be used to evaluate the subjective quality of Sleep in these with score ranging from 0 to 21. In this, high scores indicate poorer sleep quality and vice versa, with a score more than 5 suggests significant sleep problems.

III. **Depression, Anxiety and Stress Scale-Hindi** – This scale is a self-reported questionnaire of 42 items which is used to measure the state of depression, anxiety and stress.

IV. **Menopause Rating Scale-Hindi** – It is a questionnaire which is developed to evaluate the severity of menopausal symptoms in menopausal women. This questionnaire has different questions such as Hot flushes, Sweating, Heart discomfort, Sleep problems, Depressive mood, Irritability, anxiety, Physical and mental exhaustion, Joint and Muscular discomfort, Sexual problems, Bladder problems and the dryness of Vagina with a total score of 44.

Operational Definition:

- **Physical Performance:** Physical performance refers to the measurable ability of an individual to perform physical activities efficiently. In this study, it will be evaluated using objective measures, including handgrip strength, muscular strength and endurance (Wall Squat test and abdominal plank test), flexibility (Sit-and-reach test), Balance (Berg Balance Scale), Cardiovascular endurance (6-minute walk test), agility

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(10 X 4 shuttle Run test), and BMI. These metrics collectively provide a comprehensive assessment of an individual's physical capabilities.

- **Sleep Quality:** Sleep quality is defined as an individual's subjective assessment of how well they sleep. It includes factors such as sleep duration, latency and efficiency of Sleep, number of awakenings during the night, and how rested and refreshed a person feels upon waking. It will be assessed by using Hindi version of Pittsburgh Sleep Quality Index.
- **Psychological Well-being:** It refers to an individual's overall mental state, characterized by the presence of positive emotions, life satisfaction, and a sense of purpose or meaning. In this study, it will be measured through self-reported questionnaire, named DASS - 42.
- **Menopausal Symptoms:** Menopausal symptoms refer to the physical, psychological, and emotional signs and experiences associated with the transition to menopause and includes hot flashes and night sweats, joint and muscular discomfort, mood swings, dryness of vagina, disturbance in sleep and cognitive decline. We will be evaluating these symptoms using Hindi version of Menopause Rating Scale.

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Procedure

(self-prepared flowchart)

Ethical Clerance will be obtained from the Ethical Committee of Manav Rachna International Institute of Research and Studies.

↓

A sample of 385 (US Slovin Formula) will be collected.

↓

Participants will be enrolled on the basis of Inclusion and Exclusion criteria and Informed Consent will be obtained

↓

In Phase I, Questionnaire/test will be administered on peri-menopausal women to find out the level of Physical Performance and prevalence of sleep disturbances, psychological distress and menopausal symptoms among women.

↓

Analysis of Data collected in Phase I to determine the level of physical performance and Prevalence of menopausal Symptoms.

↓

In II Phase, Sample of 81 (G-Power) from the Cohort of Phase I will be taken randomly and divided in three

↓

Group A will be administered the Aerobic exercise program,

Frequency: Four time in a week

Duration – 6 Weeks

Time – 30 minutes/ session + 20 minutes for Warm up and Cool Down

Group B will be administered the Pilates exercise program,

Frequency: Four times in a week

Duration: 6 weeks

Time: 30 minutes/session + 20 minutes for Warm up and Cool Down

Group C will be a control group who will be receiving the general advice to maintain the appropriate level of Physical activity at home without any specific prescription.

↓

After administering the exercise in all the three groups, examination of physical performance and menopausal symptoms will again take place to identify the effectiveness of two different form of exercises.

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Exercise Program

Aerobic Exercise Protocol:

Time – 10 minutes for warm up, 30 minutes for aerobic exercises and then 10 minutes for the cool down

Type of exercises: Walking, Jumping Jacks, High Knees, Mountain Climbers, Lateral Jumps, Burpees.

Duration – 6 Weeks

Frequency – 4 times in a week

Repetitions – 30 seconds for 10 repetitions with 5 seconds rest between each set

Group – 5 Members in a group.

Pilates Exercise Protocol:

Time - 10 minutes for warming up, 30 minutes of main session and 10 min for the cool down.

Type of Exercises – Half Curl, Single & Double Leg Stretch, Single and Double Leg Circles, Spin Stretch Forward, Hundred, Saw, Crisscross, Curl up.

Duration – 6 weeks.

Frequency – 3 times in a week

Repetitions – 10 repetitions, 2–5 sets with a 10 second rest between each repetition and 60 seconds between sets.

Group – 5 Members in a group.

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Expected Outcome of the research

The study will find out the prevalence and assess the severity of the menopausal symptoms among perimenopausal women of India, providing valuable baseline data for future research and interventions.

We expect to see enhancements in physical performance metrics such as muscle strength and endurance, flexibility, balance, cardiovascular fitness & agility and the menopausal symptoms such as sleep quality, psychological well-being among participants in both the aerobic and Pilates groups. After completion of the study, we will determine which form of exercise aerobic or Pilates is more effective in alleviating menopausal symptoms, enhancing physical performance, improving sleep quality, and boosting psychological well-being. The findings will also contribute to a comprehensive understanding of how physical performance, sleep quality, and psychological well-being are interrelated and how they collectively impact menopausal symptoms. Based on the outcomes, we will provide recommendations for tailored exercise interventions that could effectively support perimenopausal women in managing these symptoms and improving their quality of life

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